REFERENCES

Getchell TV, Bartoshuk LM, Doty RL, Snow JB Jr (Eds): Smell and Taste in Health and Disease. New York, NY, Raven Press, 1991

Serby MJ, Chobor KL (Eds): Science of Olfaction. New York, NY, Springer-Verlag, 1992

Positron Emission Tomographic Imaging of the Head and Neck

ALTHOUGH POSITRON EMISSION TOMOGRAPHY (PET) has been used primarily as a research tool, advances in this technology have made it a powerful diagnostic tool as well. It complements the information obtained from computed tomography (CT) and magnetic resonance imaging (MRI) by demonstrating disorders of function in the absence of any anatomic abnormalities. Positron emission tomography produces images that reflect the distribution of decaying radioisotopes in vivo. Some radioactive isotopes decay by emitting a positron (positively charged electron) that collides with a local electron, resulting in annihilation. This reaction releases two photons traveling at 180 degrees of each other that are then detected by opposite radiation detectors arranged in a ring around the patient. These short-lived radioisotopes are incorporated into compounds such as water, carbon dioxide, glucose, and receptor-binding ligands. Fluorine 18-labeled 1-fluoro-2-deoxyglucose (fludeoxyglucose [^{18}FDG]), for example, is a glucose analogue that can be used to measure local glucose metabolism.

Positron emission tomography is being investigated for use in head and neck tumors. In both primary and metastatic tumors, aerobic glycolysis is often increased. Using the glucose analogue ^{18}FDG, PET can delineate these areas of hypermetabolism and identify primary tumors not detected by anatomic imaging. For example, PET can detect head and neck lymphoma and squamous cell carcinoma, which are seen as areas of increased ^{18}FDG accumulation. Because some submucosal or superficial head and neck tumors do not distort tissue planes or invade adjacent structures, MRI and CT may not detect them. Similarly, postirradiation or postsurgical anatomic changes may appear similar to recurrent tumor by conventional techniques. Furthermore, small tumor-infiltrated lymph nodes that are judged nonmetastatic by MRI or CT sometimes are visible on PET because of their increased metabolic activity. Although increased ^{18}FDG uptake in lymph nodes is not pathognomonic for metastasis, early experience suggests that in some cases it may be a sensitive indicator of nodal disease. Overall, there is potential for improving the evaluation of malignant lesions.

Positron emission tomography is also under study to determine the effectiveness of radiation therapy in head and neck cancers. Patients undergoing chemotherapy or radiation therapy may be better managed now that PET can provide information on tumor regression. Tumors responding to therapy show decreased ^{18}FDG uptake, whereas sites of recurrence can be detected by increased uptake. Also, studies have shown that substantial correlation exists between ^{18}FDG uptake and histologic grade; this deserves further investigation.

Although PET is expensive and requires a nearby cyclotron for the synthesis of short-lived radioisotopes, it has the potential to detect carcinomas not evident with other imaging techniques such as MRI or CT. Rather than replacing MRI or CT, PET may complement these techniques in the management of head and neck cancers.

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REFERENCES

Hawkins RA, Hoh CK, Glaspy J, et al: The role of positron emission tomography in oncology and other whole-body applications. Semin Nucl Med 1992; 22:268-284

Jabour BA, Choi Y, Hoh CK, et al: Extracranial head and neck: PET imaging with 2-[^{18}F]fluoro-2-deoxy-D-glucose and MR imaging correlation. Radiology 1993; 186:27-35

Maisey M, Jeffery P: Clinical applications of positron emission tomography. Br J Clin Pract 1991; 45:265-272

Shtern F: Positron emission tomography as a diagnostic tool: A reassessment based on literature review. Invest Radiol 1992; 27:165-168

Preserving Hearing in Acoustic Neuroma Removal

RECENT ADVANCES IN MICROSURGERY for the excision of acoustic neuromas now allow the hearing to be preserved. These tumors arise from the vestibular nerve; the facial and cochlear nerves are intimately adherent and at risk for injury during tumor removal. A team approach with a skilled microneurosurgeon and a neuro-otologist experienced in temporal bone operations is essential. Technical advances during the past decade in neuroimaging, audiology, neurophysiology, neuroanesthesia, and operating rooms with microsurgical instruments and continuous intraoperative monitoring make these procedures possible.

Magnetic resonance imaging (MRI) using radioactive gadolinium provides excellent multiplanar views of acoustic neuromas with detailed relationship to critical neural structures. Computed tomography (CT) complements the anatomic detail of MRI by showing the bony labyrinthine structures and internal auditory canal in the temporal bone. Details of temporal bone structure are important to preserve the semicircular canals and labyrinth while the internal auditory canal is opened with a high-speed drill to view the tumor.

Preoperative neuroimaging, audiometric and electrophysiologic evaluation with pure-tone testing, speech reception threshold, speech discrimination scores, and brain-stem auditory evoked responses are key prognostic indicators for preserving the hearing. A speech reception threshold of less than 50 dB and speech discrimination scores of greater than 50% are considered minimal "serviceable" hearing indicators for surgically preserving the hearing; yet simply "hearing spoken words" is a good practical assessment of "useful" hearing. These preoperative evaluations give surgeons invaluable information for surgical planning and for counseling patients regarding hearing preservation.

Selecting the operative approach often depends on the size and location of the tumor and the surgeon's preference. The suboccipital approach is preferred for larger tumors (1.0 cm in diameter) that extend into the posterior fossa, and the middle fossal approach is preferred for smaller tumors (<1.0 cm in diameter) within the internal auditory canal. The results of hearing preservation for each approach are similar with experienced surgeons.

The overall rate of hearing preservation with acoustic neuroma removal in the current literature ranges from 12% to 59%. With smaller acoustic neuromas (<1.0 cm), there is a greater chance of preserving the hearing (48% to 75% in recent series). Tumors of 1.0 to 2.0 cm have hearing preservation rates approaching 50%, but larger tumors (>2.0 cm) have a much poorer prognosis (0% to 20% hearing preservation) depending on preoperative hearing function. These results contrast with those formerly obtained with surgical acoustic tumor removal, which usually included deafness, facial paralysis, and a 10% mortality rate.

Success in preserving hearing with acoustic neuroma removal has grown steadily in the past decade. This is achieved in more than 50% of patients with smaller tumors, yet the results are less impressive in patients with large tumors. Advances in microsurgical techniques, intraoperative monitoring, and preoperative patient selection will continue to improve these results.

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REFERENCES

Ebersold MJ, Harner SG, Beatty CW, Harper CM Jr, Quast LM: Current results of the retrosigmoid approach to acoustic neurinoma. J Neurosurg 1992; 76:901-909

Fischer G, Fischer C, Remond J: Healing preservation in acoustic neurinoma surgery. J Neurosurg 1992; 76:910-917

Microvascular Free Flaps in Head and Neck Reconstruction

MICROVASCULAR FREE FLAPS have expanded the scope of options available for the reconstruction of head and neck defects that result from tumor ablation or trauma. The technique involves transferring soft tissue or bone with its vascular pedicle from a distant site to the head and neck region and reestablishing blood flow through the transferred flap by anastomosis of the vascular pedicle to vessels in the neck. In the past, major defects in the head and neck region were reconstructed using pedicled flaps. The length of the pedicle is a limiting factor with this reconstruction technique, and only a few flaps are available—generally muscle and skin flaps from the chest and back. With microvascular techniques, tissue can be transferred from distant sites.

Microvascular free flaps can be fasciocutaneous (skin with underlying subcutaneous tissue), myogenous, myocutaneous, osseous, osteocutaneous, osteomyocutaneous, or visceral. The common donor sites for fasciocutaneous flaps are forearm, lateral upper arm, scapular region, and lateral thigh. The most commonly used myogenous or myocutaneous free flaps are rectus abdominis and latissimus dorsi. These fasciocutaneous and muscle flaps are used to reconstruct soft tissue defects in the head and neck region. Important applications of these flaps have been in the reconstruction of massive defects involving the face, scalp, or cranium. Such defects are extremely difficult, if not impossible, to reconstruct with local and regional pedicled flaps because of the limited arc of rotation and surface area. These factors are eliminated with the use of microvascular free flaps. Furthermore, in the reconstruction of extensive craniofacial defects, a healthy vascularized free flap can effectively and reliably seal off the cranium from extracranial communication, minimizing the incidence of cerebrospinal fluid leak and intracranial infections.

A newer application of revascularized soft tissue flaps is the restoration of sensation to the area of the oral cavity and pharynx that has been resected. In such a case, the fasciocutaneous flap is harvested together with its sensory nerve, which is then anastomosed to an appropriate sensory nerve supplying the area of the defect being reconstructed, such as the tongue, floor of the mouth, or the pharynx. The purpose of reconstructing with such a "sensate" flap is to help restore the ability to swallow. The preliminary results appear encouraging, though large series are necessary to determine the efficacy of this technique. Various vascularized bone flaps can be harvested together with an overlying flap of skin for reconstructing mandibular or maxillary defects. The most important application of osseocutaneous free flaps is the reconstruction of the anterior mandibular arch. Common donor sites are the iliac crest, the fibula, and the scapula. Visceral flaps are also used in head and neck reconstruction, where a segment of the jejunum is used to reconstitute segmental pharyngeal and upper esophageal defects.

Free revascularized tissue transfer has many advantages over traditional pedicled flaps. As a variety of donor flaps from distant sites are available, a defect in the head and neck region can be "custom fitted" with a flap of appropriate size and contour in a single-stage procedure to restore form and function while not sacrificing these same needs at the donor site. Closing a defect and restoring function are possible with a single-stage procedure. After tumor ablation, reconstruction with vascularized tissue allows the patient to undergo postoperative radiation therapy with little risk of wound complications. This is particularly the case with defects involving the anterior mandible and oral cavity. Before the popularity of vascularized osseous flaps, this type of defect was often reconstructed with a stainless steel or titanium mandibular reconstruction plate and a pectoralis myocutaneous pedicled flap to cover the plate inside the mouth. This frequently resulted in intraoral plate exposure caused by the gravitational pull of the pedicled flap. Furthermore, the plate often eroded through the external skin during or after the completion of radiation therapy. The use of revascularized osseocutaneous flaps has virtually eliminated